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A unified framework for postoperative complications after gastrectomy for gastric cancer: insights from the Korean Quality Improvement Platform in Surgery program

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Purpose: Postoperative complications following gastric cancer surgery significantly impact patient outcomes, yet standardized definitions for these events have not been consistently applied across institutions in Korea. This study aimed to develop a consensus-based, standardized complication classification system specific to gastrectomy for gastric cancer as part of the Korean Quality Improvement Platform in Surgery (K-QIPS) initiative.
Methods: As part of K-QIPS, a dedicated task force team (TFT) was formed with surgical experts from fourteen high-volume hospitals across Korea. The TFT conducted ten formal meetings to review existing literature and international guidelines, and incorporated findings from randomized controlled trials. The final complication list was developed through expert consensus and structured into a standardized framework. A Data Entry Manual was created to support consistent data collection by surgical clinical reviewers.
Results: The TFT defined specific postoperative complications following gastrectomy for gastric cancer, including anastomotic leakage, duodenal stump leakage, pancreatic fistula, intra-abdominal and luminal bleeding, delayed gastric emptying, and internal hernia. Notably, internal hernia was described in standardized form for the first time. General complications were developed first and overlapped in part with the gastric cancer-specific list. The task force also produced a Data Entry Manual that provides practical instructions to ensure consistency and accuracy in complication reporting.
Conclusion: This nationwide consensus initiative established the first standardized complication classification system for gastric cancer surgery in Korea. The proposed definitions and data entry system are expected to improve complication reporting, enable multicenter research, support surgical quality benchmarking, and ultimately enhance patient outcomes.
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INTRODUCTION

Gastric cancer continues to be a major global health burden, ranking among the leading causes of cancer-related mortality, especially in East Asian countries such as Korea and Japan [1]. Surgical resection, including gastrectomy with lymph node dissection, remains the primary curative approach and has markedly improved patient survival in recent decades [2,3]. However, despite advances in minimally invasive techniques and perioperative care, postoperative complications remain a significant obstacle, potentially compromising recovery, prolonging hospital stays, and affecting long-term functional and oncologic outcomes [4,5]. Therefore, careful monitoring and management of these complications are critical for achieving optimal surgical results and enhancing patient quality of life.

While a standardized system for defining and classifying these events in gastric cancer surgery does exist [6-8], its use remains inconsistent across institutions and studies. Many researchers and clinicians continue to apply differing criteria, often shaped by institutional preferences or regional practices, leading to inconsistencies that hinder reliable comparisons and limit the development of unified clinical guidelines.

To address this challenge, the Korean Surgical Society launched the Korean Quality Improvement Platform in Surgery (K-QIPS) in 2023, in collaboration with the Ministry of Health and Welfare and the Korean Surgical Research Foundation. The K-QIPS is a nationwide quality improvement initiative designed to enhance surgical outcomes and patient safety by standardizing postoperative complication definitions, data collection systems, and performance feedback mechanisms. The program initially targets 5 major surgical domains—gastric, colorectal, hepatobiliary and pancreatic, and kidney transplant surgeries—by establishing both general and disease-specific complication frameworks. This platform aims to create a unified national database that supports benchmarking, surgical quality control, and future artificial intelligence-based clinical decision support [9].

In this context, a dedicated task force within K-QIPS has developed a consensus-based, standardized complication classification system specifically for gastrectomy in gastric cancer. By consolidating expert insights and current evidence, this consensus initiative aims to provide a clear and unified reference that can be widely adopted in both clinical practice and research settings. This study described the development of that standardized system and demonstrated how its implementation can improve the consistency and quality of complication reporting across institutions.

METHODS

Ethics statement

This study was approved by the Institutional Review Board of Ajou University Hospital (No. AJOUIRB-DB-2023-457), which granted a waiver for written informed consent due to the retrospective nature of the cohort design.

Task force team to define gastrectomy complications in the K-QIPS

The K-QIPS initiative consists of 6 detailed subprojects, each designed to improve surgical outcome reporting and standardize complication definitions across various major surgical fields [9]. The first subproject focuses on defining general complications occurring in general abdominal surgeries to establish a unified framework that can be broadly applied. The first subproject of the K-QIPS initiative focused on defining general complications occurring in major abdominal surgeries. The task force reviewed complication categories and definitions used in major surgical quality improvement programs, including the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) and a Korean national study on surgical quality improvement for cholecystectomy patients conducted by the National Evidence-based Healthcare Collaborating Agency (NECA) [10]. Based on these references, a draft list of complication categories was created and refined through iterative multidisciplinary discussions involving gastrointestinal, hepatobiliary-pancreatic, colorectal, and kidney transplant surgeons. Final consensus was reached after evaluating the clinical relevance, clarity, and exclusivity of each category.

Building upon this foundation, the second subproject of the K-QIPS specifically targets complications related to gastric cancer surgery, providing detailed and disease-specific definitions. The remaining subprojects target other major surgical domains, including colorectal surgery (third subproject), hepatectomy (fourth), pancreatectomy (fifth), and kidney transplantation (sixth), thereby creating comprehensive, procedure-specific complication frameworks throughout the program.

As part of its second key project, the K-QIPS has prioritized improving surgical outcomes in gastric cancer, a condition with particularly high prevalence in Korea. To establish a comprehensive and objective system for documenting postoperative complications after gastrectomy, a dedicated task force team (TFT) was formed (Supplementary Table 1). This TFT brought together representatives from major tertiary hospitals nationwide, aiming to create unified definitions and classifications for complications occurring within 30 days after gastrectomy for gastric cancer. Over the course of the project, the team held 10 formal meetings, both online and in person,

to review existing criteria, share institutional experiences, and reach a consensus on standardized complication definitions applicable to Korean surgical practice.

Establishment of a standardized complications framework

To develop a comprehensive and practical list of postoperative complications after gastric cancer surgery, the TFT reviewed evidence from several key sources. The group first examined data from Korea's representative randomized controlled trials, KLASS-01 and KLASS-02, which have provided robust insights into gastrectomy outcomes [11,12]. Additionally, the TFT referred to the international consensus on a complications list after gastrectomy for cancer, as well as relevant studies from Japan, China, and the Netherlands, to ensure that the final list reflected a broad international perspective [6-8,13-15]. Based on this extensive review, the TFT summarized and refined a standardized list of complications and provided clear definitions and diagnostic criteria for each event.

To promote objective and unbiased data collection, the K-QIPS system mandates that surgical clinical reviewers (SCRs), rather than the surgeons themselves, extract and enter complication data by thoroughly reviewing patient medical records. Recognizing that SCRs may have limited clinical context compared to attending physicians and, thus, may encounter difficulties in accurately identifying postoperative complications, the TFT collaborated with SCRs to develop a comprehensive Data Entry Manual to enhance data accuracy and consistency.

RESULTS

General complications list for general abdominal surgeries: standardized list developed by the K-QIPS task force

The K-QIPS defines complications as any adverse event occurring within 30 days after surgery, as identified through a review of the patient's medical records or electronic medical records, including progress notes, laboratory results, prescription records, and other complication-related documentation. The complication date is defined as that on which a diagnostic test was performed to confirm the complication following symptom onset, or the date on which treatment for the complication was initiated. The severity of each complication is classified using the Clavien-Dindo classification system [16].

As part of the first subproject within the K-QIPS initiative, a standardized list of general postoperative complications associated with general abdominal surgeries was developed. This list serves as a foundational reference across multiple surgical specialties and was formulated based on expert consensus and a review of relevant literature. Although not specific to gastric cancer, these standardized definitions provide a unified framework to enhance consistency in complication reporting. The K-QIPS framework defines general complications as systemic or common postoperative complications that may occur after major abdominal surgeries, regardless of disease type. These general complications are summarized in Table 1.

Standardized definitions of postoperative complications after gastric cancer surgery and the Data Entry Manual developed by the task force team

The standardized definitions of postoperative complications and the corresponding Data Entry Manual developed by the

Table 1. General complications list for general abdominal surgeries: standardized list developed by the K-QIPS task force

Category	Complications
Systemic	
Pulmonary	Pneumonia
	Pulmonary embolism
	Pneumothorax
	Pleural effusion
	Other
Cardiovascular	Myocardial infarction
	Cardiac arrest
	Arrhythmia
	Deep vein thrombosis
	Other
Hepatic	Acute liver failure
	Other
Renal and urinary system	Urinary tract infection
	Acute renal failure
	Other
Endocrine	Adrenal insufficiency
	Hypothyroidism
	Other
Gastrointestinal system	Clostridioides difficile infection
	Other
Infection	Sepsis
	Phlebitis
	Central line infection
	Other
Neurologic system	Cerebral infarction
	Cerebral hemorrhage
	Other
Psychiatry	Delirium
	Other
Other	Pressure ulcers
	Falls
	Drug hypersensitivity reactions
	Transfusion hypersensitivity
	Other
Surgery-related	Surgical site infection
	Postoperative bleeding
	Paralytic ileus
	Intestinal obstruction

K-QIPS, Korean Quality Improvement Platform in Surgery.

Table 2. Standardized definitions of postoperative complications after gastric cancer surgery and the Data Entry Manual developed by the task force

Complications	Definition	Clinical manifestations	Diagnosis	Considerations for surgical clinical reviewers
Anastomotic leakage	Leakage of intestinal contents from the digestive tract anastomosis (e.g., esophagogastric, esophagojejunal, gastroduodenal, gastrojejunal, or jejunojejunal). (Excludes duodenal stump leakage, check separate box below).	Local inflammation and abscess formation due to spilled intestinal contents cause clinical symptoms such as abdominal pain, peritoneal irritation, fever, inflammatory findings such as leukocytosis and increased CRP, and discharge of turbid fluid or digestive tract contents from the drainage tube.	CT imaging shows a large amount of fluid or gas in the abdominal cavity, or an air-fluid layer in the abscess cavity. Alternatively, endoscopy, UGI series with water-soluble contrast, or fistulography may be performed.	Abdominal CT scan, endoscopy, UGI series, etc. are the first to be confirmed. If additional procedures were performed due to fluid collection or intra-abdominal abscess secondary to leakage, these should not be double-counted under the category of fluid collection or intra-abdominal abscess.
Anastomotic stricture	Narrowing of the anastomotic site (e.g., esophagogastric, esophagojejunal, gastroduodenal, gastrojejunal, or jejunojejunal).	Oral ingestion causes symptoms of epigastric bloating, nausea, and vomiting, which improve with suctioning or drainage of stomach contents.	Abdominal radiographs may show distension proximal to the anastomosis and collapse distal to it, and endoscopy or CT imaging may confirm narrowing of the anastomosis (mechanical obstruction). If there is no mechanical obstruction of the anastomosis and food emptying is slow, see delayed gastric emptying below.	Check for evidence of stenosis on endoscopy and UGI series first.
Duodenal stump leakage	Leakage from a duodenal stump transected after gastrectomy	Localized abscess formation with bile and digestive fluid leakage; clinical symptoms such as right upper quadrant abdominal pain, peritoneal irritation, and fever; inflammatory findings such as leukocytosis and elevated CRP; and dark green bile color in the drainage tract.	CT scan shows an abscess around the duodenal stump, dark green coloration of the drainage tube, and elevated total bilirubin/amylase/lipase on drainage tube examination. It can also be confirmed by imaging tests such as percutaneous drainage or fistulography.	During the postoperative recovery period, the possibility of duodenal stump leakage should first be evaluated when the drainage fluid changes in character to digestive or biliary content, or when suspicious findings are observed on abdominal CT or drain fluid analysis. If the diagnosis remains uncertain, additional procedures such as percutaneous drainage or fistulography can be used for confirmation. If fluid collection or intra-abdominal abscess develops as a consequence of leakage and requires further intervention, this should not be double-counted under the category of fluid collection or intra-abdominal abscess.
Intraabdominal bleeding	Bleeding that occurs in the abdominal cavity (omentum, abdominal wall, lymph node dissection site, ligated vessels, gastric/duodenal resection line, etc.)	Intra-abdominal bleeding may present with abdominal distension, tenderness, and decreased hemoglobin levels, and can also manifest as fresh or sanguineous fluid in the surgical drain, often accompanied by tachycardia or hypotension in severe cases.	Persistent bleeding through a surgical drain, or CT imaging, angiography, or reoperation demonstrates a large amount of hematoma pooling in the abdominal cavity.	Check if the drainage changes to a bleeding pattern during the postoperative recovery process, bleeding CT (contrast) or angiography results, or emergency surgery performed due to suspected intra-abdominal bleeding. If additional procedures were performed due to fluid collection or intra-abdominal abscess secondary to bleeding, these should not be double-counted under the category of fluid collection or intra-abdominal abscess.

Table 2. Continued 1

Complications	Definition	Clinical manifestations	Diagnosis	Considerations for surgical clinical reviewers
Luminal bleeding	Bleeding that occurs in the lumen of the intestine (primarily the lining of the esophagogastric, gastroduodenal, gastrojejunal, and jejunojejunal anastomoses)	Luminal bleeding may present with hematemesis, melena, or hematochezia, often accompanied by dizziness, tachycardia, hypotension, and a progressive decline in hemoglobin levels.	Diagnosis can be made by a decrease in hemoglobin of 3 or more at the time of symptoms compared to preoperative hemoglobin, with drainage of fresh blood through the nasogastric tube, or direct confirmation of hematoma pooling in the intestinal lumen by endoscopy, CT imaging or angiography, or reoperation.	Hemorrhagic vomiting, black stools, bloody stools, confirmation of bleeding through a Levin tube, endoscopy, or bleeding CT scan can confirm luminal bleeding. Grade 1: Maintain fasting Grade 2: Blood transfusions, tranexamic acid, ferinject, etc.
Pancreatic fistula	An amylase level in the drainage tube on postoperative day 3 in the absence of anastomotic leakage that meets one of the following criteria (1) >1,000 IU/L [13] (2) The amylase level in the drainage fluid is considered elevated if it exceeds three times the upper limit of normal serum amylase, according to the 2016 ISGPS (International Study Group on Pancreatic Surgery) guideline [14]. (3) In the absence of a surgical drain, a complication may be defined based on radiologic findings indicating peripancreatic inflammation.			If peripancreatic fluid collection is present and percutaneous drainage is performed, and the case meets the definitions described above, it should be recorded under both “fluid collection” and “pancreatic fistula” in the complication list.
Fluid collection	Accumulation of blood or lymphatic fluid at the surgical site, which may be accompanied by abdominal distention, pain, fever, or a change in the color of the drainage fluid. The diagnosis is based on postoperative imaging studies such as ultrasound, CT, or MRI. It is also defined based on imaging tests (ultrasound, CT, MRI) performed after surgery.			Any amount of ‘fluid collection’ on a radiologic examination can be considered a complication, but if no further examination or intervention (treatment) is performed, it is not considered a complication.
Intra-abdominal abscess	Intra-abdominal abscess is diagnosed when postoperative symptoms such as fever, abdominal pain, tachycardia, or bowel obstruction are accompanied by leukocytosis and imaging studies (ultrasound, CT, or MRI) reveal intra-abdominal fluid collection. Among cases categorized as “fluid collection,” diagnosis is confirmed when the fluid is visibly purulent or when infection is verified by microbiological culture.			Since it is often diagnosed through abdominal CT, check this first, and if it meets the above definition, check both fluid retention and intra-abdominal abscess among the complications. If the conditions of pancreatic fistula are also met, check all three items.
Delayed gastric emptying	A patient with early postoperative satiety, nausea, vomiting, and difficulty passing food in the stomach, with no specific problems such as mechanical obstruction at the anastomosis or in the small intestine, who requires more than 1 week of fasting before reintroduction [15].		Delayed gastric emptying is clinically diagnosed based on a combination of findings from endoscopy, UGI series, abdominal plain films and CT, and gastric emptying tests.	Delayed gastric emptying can only be diagnosed as delayed gastric emptying if there is no evidence of stricture in a specific area on endoscopy or digestive tract examination.
Chyle ascites	Presence of a distinct milky fluid in a drainage tube inserted into the abdominal cavity following dietary progression after gastrectomy or a triglyceride concentration in the drainage fluid greater than or equal to 100 mg/dL [16].			In the electronic medical record, first check whether a drainage tube test was ordered due to changes in the characteristics of the drainage output. If a test was performed, review the laboratory results to determine whether they meet the definition criteria for chyle ascites.

Table 2. Continued 2

Complications	Definition	Clinical manifestations	Diagnosis	Considerations for surgical clinical reviewers
Cholecystitis	Inflammation of the gallbladder with right upper quadrant abdominal tenderness, fever, and leukocytosis, diagnosed on ultrasound and CT based on findings of thickening of the gallbladder wall, contrast enhancement of the gallbladder mucosa, and contrast enhancement around the gallbladder.			Check the upper abdominal ultrasound and abdominal CT performed according to clinical symptoms. Check if the patient has had surgery for acute cholecystitis or a percutaneous transhepatic gallbladder drain.
Internal hernia	Protrusion of abdominal viscera into the abdominal and pelvic cavity through a defect in the peritoneum or mesentery, whether symptomatic or not, confirmed directly by CT findings or surgery.			First, check if the abdominal CT scan shows an internal hernia, and if there are related symptoms and emergency surgery or diagnostic laparoscopy was performed. If the intestinal obstruction is due to internal hernia, check only internal hernia.
Other	In addition to the above, provide a narrative description of any surgery-related complications that occurred within 30 days of surgery.			

UGI, upper gastrointestinal series.

TFT are summarized in Table 2. A simplified example of the SCR recording form used in the K-QIPS electronic Case Report Form system is provided to illustrate how complications are recorded (Supplementary Table 2). This form includes fields for complication type, occurrence status, date of onset, postoperative day (POD), and Clavien-Dindo classification grade. To further demonstrate how multiple overlapping complications are documented, a representative patient scenario is described. A 54-year-old woman developed a fever on POD 6 after total gastrectomy, with no specific findings on the abdominal CT scans. Persistent fever prompted a repeat CT on POD 9, which revealed duodenal stump leakage; percutaneous catheter drainage was performed (duodenal stump leakage, Clavien-Dindo grade IIIa). On POD 20, she suddenly developed severe abdominal pain, nausea, and dyspnea accompanied by hypotension (60/30 mmHg). CT demonstrated a large intra-abdominal hematoma caused by splenic artery pseudoaneurysm rupture, for which embolization and additional drainage were performed, followed by intensive care unit admission (intra-abdominal bleeding, grade IVa). This example illustrates how each complication was recorded independently with its corresponding Clavien-Dindo grade within the K-QIPS framework.

DISCUSSION

This study is the first nationwide initiative in Korea to establish standardized definitions and classifications for postoperative complications following gastric cancer surgery through a multicenter collaborative effort. While similar frameworks have been developed in other countries, such as Italy, and in international consensus guidelines [6,7], no such system had previously been formally implemented in Korea. By integrating both global evidence and real-world clinical experience, the K-QIPS TFT developed a set of definitions that are both evidence-based and highly applicable to the Korean clinical setting.

International efforts have been made to standardize the definition of postoperative complications following gastric cancer surgery. For instance, Italian and international guidelines [6,7] provide comprehensive classifications that include both intraoperative (major vascular or organ injury, intraoperative bleeding requiring urgent intervention, and unexpected medical events) and general systemic (stroke, myocardial infarction, pulmonary embolism, respiratory failure, and renal dysfunction) complications (Supplementary Table 3). These guidelines also detail surgical complications, including anastomotic leakage, duodenal stump leakage, pancreatic fistula, and delayed gastric emptying, using specific diagnostic and treatment-based criteria.

The K-QIPS complications list closely aligns with many

of these international standards, particularly regarding key postoperative surgical events. However, intraoperative complications are not classified as a separate category under the K-QIPS system; instead, they are recorded as "Other" when identified during medical record review. This decision reflects the predominance of postoperative complication reporting in surgical literature, as postoperative events are more clearly defined, objectively measurable, and systematically documented in medical records, readmission databases, and follow-up data. In contrast, intraoperative complications often lack standardized diagnostic criteria, are inconsistently documented in operative notes, and may be subject to reporting bias due to medico-legal concerns, professional pressure, or ambiguity in distinguishing technical challenges from true adverse events. To ensure consistent and reproducible data entry, especially by non-surgeon SCRs, the current K-QIPS framework classifies intraoperative complications within the "Other" category.

If widely adopted across institutions, the standardized complication definitions proposed by the K-QIPS initiative may significantly enhance the reliability of reported complication rates, improve comparability between hospitals, and strengthen surgical quality indicators at a national level. In particular, the implementation of a data entry system led by SCRs, supported by the detailed Data Entry Manual, contributes to more objective and consistent data collection while reducing interobserver variability and documentation errors. This structured approach is expected to facilitate more accurate benchmarking and support data-driven quality improvement initiatives in gastric cancer surgery.

This Data Entry Manual provides not only standardized definitions and objective diagnostic criteria for each complication but also outlines relevant imaging and laboratory findings and provides practical tips to help SCRs efficiently and accurately identify complications within a limited review timeframe. By supporting consistent interpretation and documentation, the manual serves as a key resource to minimize underreporting and ensure reliable, high-quality data collection across participating institutions.

Despite this structured guidance, variability may still arise owing to differences in individual SCR's ability to extract and interpret data. Therefore, future validation studies are warranted to assess the inter-rater reliability of complication recording among non-surgeon SCRs across institutions. Such assessments are essential for verifying the reproducibility and robustness of the Data Entry Manual, similar to the validation processes applied for the Clavien-Dindo and Accordion classifications.

One distinctive feature of this complication classification system is the two-tiered design, in which the general complications list was developed first, followed by the creation of the gastric cancer-specific definitions. Consequently, some overlap exists between the 2 categories. For example, while "bleeding" appears in the general list, the gastric cancer-specific definitions further divide it into intra-abdominal and luminal bleeding, enabling more detailed and procedure-specific classification within the context of gastrectomy. Notably, internal hernia, a well-recognized but previously underdefined complication following gastric cancer surgery, is described in detail for the first time in this study, providing a clearer diagnostic reference for future clinical and research applications.

The definitions proposed in this study are based on an expert consensus and have not yet been fully validated through nationwide implementation. Some complications leave room for subjective interpretation by radiologists or SCRs, which could introduce variability in data collection. Additionally, the current framework is restricted to complications occurring within 30 days postoperatively and does not capture longer-term events that may impact patient outcomes. Thus, these definitions and criteria will require ongoing refinement and modification based on future multicenter validation studies and feedback from real-world clinical applications.

In conclusion, this nationwide, multicenter consensus project established the first standardized framework for defining and recording postoperative complications after gastric cancer surgery in Korea. Beyond standardization itself, this initiative represents a shift toward a culture of transparency and data-driven quality improvement in surgical practice. By introducing a structured Data Entry Manual and SCR-based recording system, the framework provides a practical model for harmonizing clinical documentation across institutions. Ultimately, the K-QIPS framework is expected to serve as a foundation for continuous surgical quality benchmarking, national outcome evaluation, and future international collaboration in gastric cancer surgery.

SUPPLEMENTARY MATERIALS

Supplementary Tables 1–3 can be found via https://doi.org/10.4174/astr.2026.110.5.290.

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Conflict of Interest

Jong Won Kim, Hyoung-Il Kim, Ji Yeon Park, Sang-Yong Son, and Mi Ran Jung serving as Editorial Board of *Annals of Surgical Treatment and Research*, did not participate in the review process of this article. No other potential conflicts of interest pertinent to this article were reported.

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